

Broad Run

Watershed Study

Montgomery County

Department of Environmental Protection

Watershed Management Division

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Executive Summary

In the year 2000, Montgomery County Department of Environmental Protection monitored stream conditions at seven 75-meter stations within the Broad Run Watershed. This watershed is located in western Montgomery County, MD (Figure 1). The parameters examined include: benthic macroinvertebrates, fish communities, water chemistry, and quantitative habitat. All parameters were scored and placed in one of four stream categories including *poor*, *fair*, *good*, and *excellent*. Overall, Broad Run Watershed is in relatively *good* condition. Water quality results for all stations were within the desired Maryland Department of the Environment Use I stream classification criteria. Three temperature loggers, placed into various areas of the watershed for 3-4 months, recorded desirable temperatures according to the MDE criteria. Three stations have *good* habitat, fish, and benthos (BRBR106, 401, 406). Two other stations (BRBR403, 409) have *good* fish, but the benthos scored *fair*. One of the stations, BRBR201, has moderate entrenchment, allowing for more likelihood that pioneering species will be found due to floodwaters being contained within the active channel. During the next scheduled monitoring of Broad Run field habitat parameters should be examined for BRBR 201, 403, and 409. One station, BRBR302, shows no physical signs for impairment, however, both the fish and benthos are scoring lower than expected in this reach. Water chemistry, agricultural management plans, and other field assessments should be investigated at BRBR 302 to determine why both fish and benthic communities are impairment.

I. Purpose of this Report

The purpose of this report is to:

- Assess the existing stream conditions of Broad Run Watershed,
- Identify stream reaches with impairment from other than habitat stressors,
- Identify stream reaches with unstable habitat features that, if left alone, could further degrade the biological community of the stream, provide recommendations for follow up actions concerning the identified areas of impaired stream reaches.

II. Introduction to the Watershed (excerpted from the Countywide Stream Protection Strategy)

The Broad Run originates west of Poolesville near Wasche Road and West Hunter Road. Flowing south toward the Potomac River, it passes through a part of Montgomery County that has changed little in over one hundred years. This region, a part of the County's agricultural preserve, is characterized by rolling hills and many forested stream buffer areas (Figure 2). The watershed has red Triassic sandstone, with soils that tend to be droughty; consequently, the Broad Run can have low base flows during the summer months.

County biologists monitored the Broad Run during the summer of 1996, above River Road. This part of the stream is in a wide forested stream valley, just downstream of the NIH Animal Center. Stream habitat was in good condition with stable overhanging banks providing excellent fish cover, frequent riffles, and stream base flow reaching both lower banks with little channel substrate exposed. Seventeen species of fish were found in the lower Broad Run including largemouth bass and five species of sunfish. A caddisfly (*Ochrotrichia* sp.) was found in this watershed that had not been identified elsewhere in the County through the County's stream monitoring program. If the identification is

verified, it would add a new taxon to the County's list of benthic macroinvertebrates. Grab samples for water chemistry for pH, dissolved oxygen, conductivity, and water temperature were all within state standards.

In the Spring, Summer, and Fall of 2000 County biologists monitored seven monitoring sites within Broad Run (Figure 1). These stations are located just north Whites Ferry and River roads. All seven stations were monitored for benthic macroinvertebrates and fish. Only one of the seven stations was evaluated during the fall for quantitative habitat analysis.



Figure 1. Monitoring Stations for 2000 Monitoring Season

Broad Run, Horsepen Branch, Cabin Branch, Chisel Branch and Surrounding Potomac Drainage

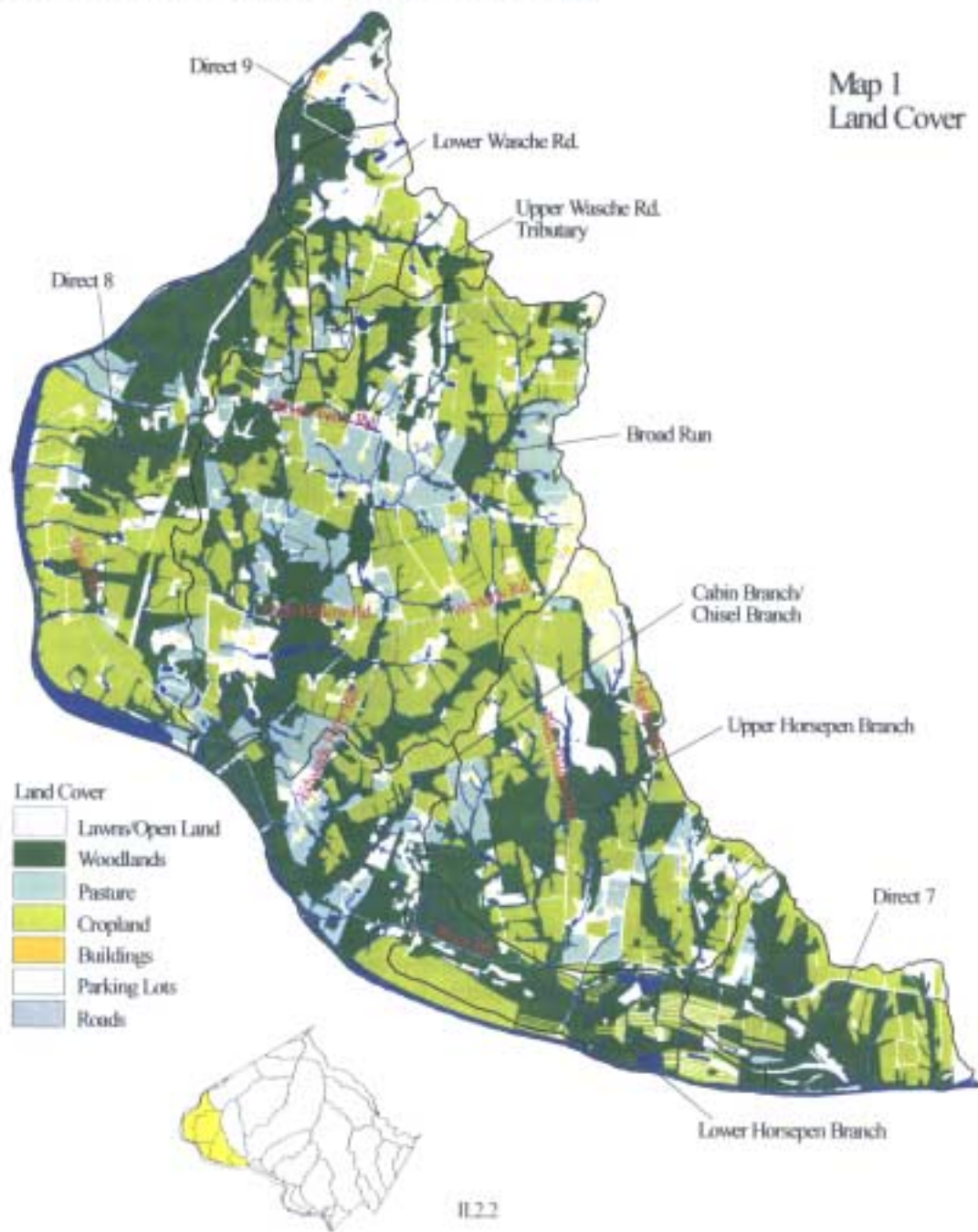


Figure 2. Land Cover for Broad Run, Horsepen Branch, Cabin Branch, Chisel Branch and surrounding Potomac Drainages.

III. Methods

All fieldwork, data reduction, and data analysis follow the Montgomery County stream monitoring protocols described in Van Ness et al 1997. The overall stream condition was determined by assessing the cumulative impacts that occurred in the watershed as indicated by the use of an interim Index of Biological Integrity (IBI) for freshwater fish and benthic Macroinvertebrates. The stream condition was made by examining the trends expressed by the two IBI's. This is not the same as averaging the two scores. Seasonal trends were examined and a yearly stream condition has been established for the subwatersheds.

Assuming that water quality is constant throughout the study area, the relationship between habitat quality and biological condition can be predictable, (Plafkin et al, 1989), and provide diagnostic information on stressors likely responsible for identified impairment to the existing stream area. Possible causes of impairment can be determined by examining the relationship between the IBI score/habitat score for each individual monitoring station (Figure 1). Percentage of the best attainable biological condition was calculated for each IBI score and compared against percentage of the best attainable instream physical habitat in order to assess relationships between habitat and biology and identify areas of stream impairment from other than physical stressors (Figure 3). The theoretical regression lines shown in Figure 1 describes the general relationship of biological condition to habitat quality in the absence of water quality effects. The highest possible IBI score for fish is 50 (100%), for benthic macroinvertebrates 40 (100%). Abiotic factors such as water temperature, water chemistry, and analysis of both qualitative and quantitative physical habitat attributes are also used to assess the types of stressors that may be affecting the system. Impaired sites are then targeted, and further investigations of the probable causes of impairment are scheduled.

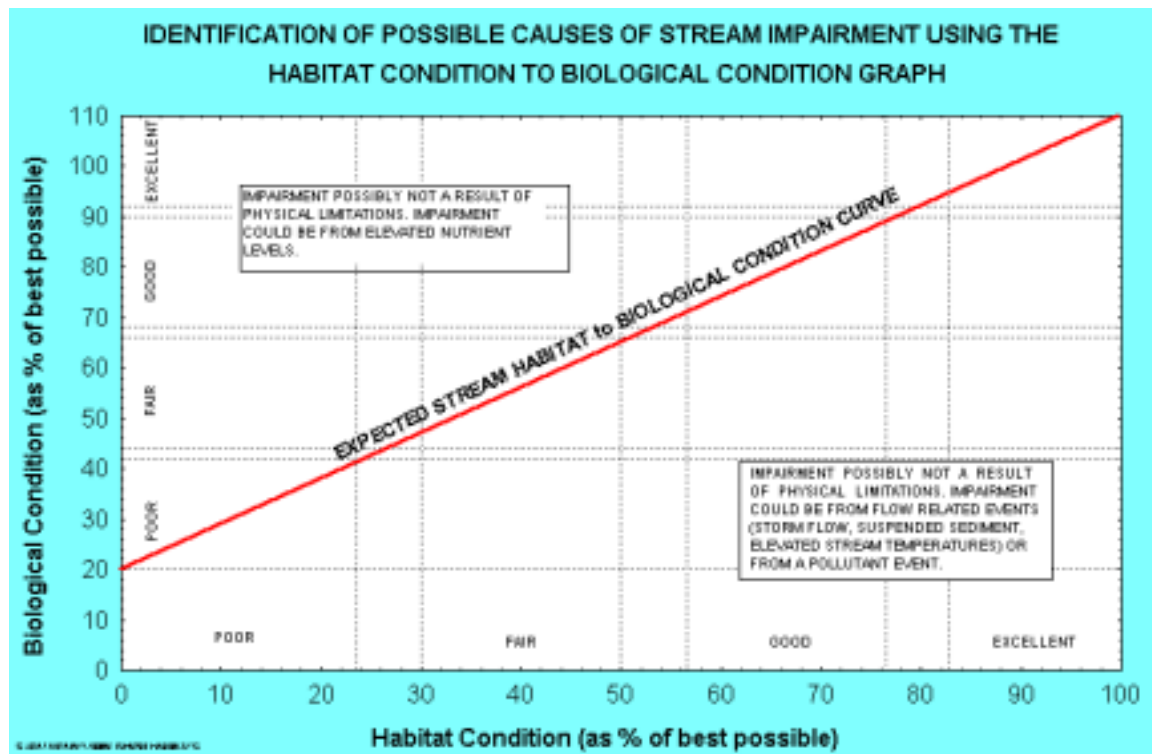


Figure 3. Conceptual Relationship between Habitat and Biological Condition

IV. Results

Stream Condition

Stream conditions for Broad Run watershed were evaluated by monitoring seven mainstem sites located from just above Whites Ferry Road down to River Road. BRBR106 is located to the east of trundle road. BRBR201 is located just north of the National Institute of Health and Animal Center and BRBR 302 is located just north of Whites Ferry Road. BRBR401 is located to the east of Edwards Ferry Road. BRBR403 is located just off of Club Hollow Road. BRBR406 is located off of Elmer School Road. BRBR409 is located just north of River Road. Majority of the monitoring sites had an overall stream condition of being in *good* condition. Only two of the seven sites, located towards the upper end of the watershed, fell in the poor range for fish (Figure 4). Three other stations fell in the fair range for benthos. One station showed impairment to both fish and benthic communities.

1. Examination of IBI/Habitat Relationships

Data from seven monitoring stations were used in the assessment of the Broad Run Watershed. Benthic Macroinvertebrates were collected in March-April, while fish surveys were conducted in June-July of 2000.

Fish

The majority of the stations (BRBR 106, 401, 403, 406) had a rating for both fish and habitat conditions as *good* (Figure 4). BRBR409 had a fish rating of *good*, while its habitat condition rated as *excellent*. Five stations seem to show that they are sustaining an overall *good* fish community. All Broad Run stations appear to have a percentage of pioneering species of fish (Table 1). Predominately, as expected, smaller drainage areas increase the number of pioneering fish species since they are the first species to repopulate a previously dried stream.

Table 1. Number of Pioneering Fish Species per Station

Station	# Of Pioneering	Total Fish	% Of Pioneering
BRBR 106	457	611	75
BRBR 201	10	11	91
BRBR 302	81	120	68
BRBR 401	159	476	33
BRBR 403	228	522	44
BRBR 406	198	436	45
BRBR 409	37	376	10

Benthic

Three of the seven stations (BRBR302, 403, 409) had a rating for habitat as *good*, but fell in the *fair* range for benthos (Figure 4). BRBR406 scored *good* habitat, but scored on the lower end of *good* for the benthos. The other three stations (BRBR106, 201, 401) had a *good* rating for both benthos and habitat conditions.

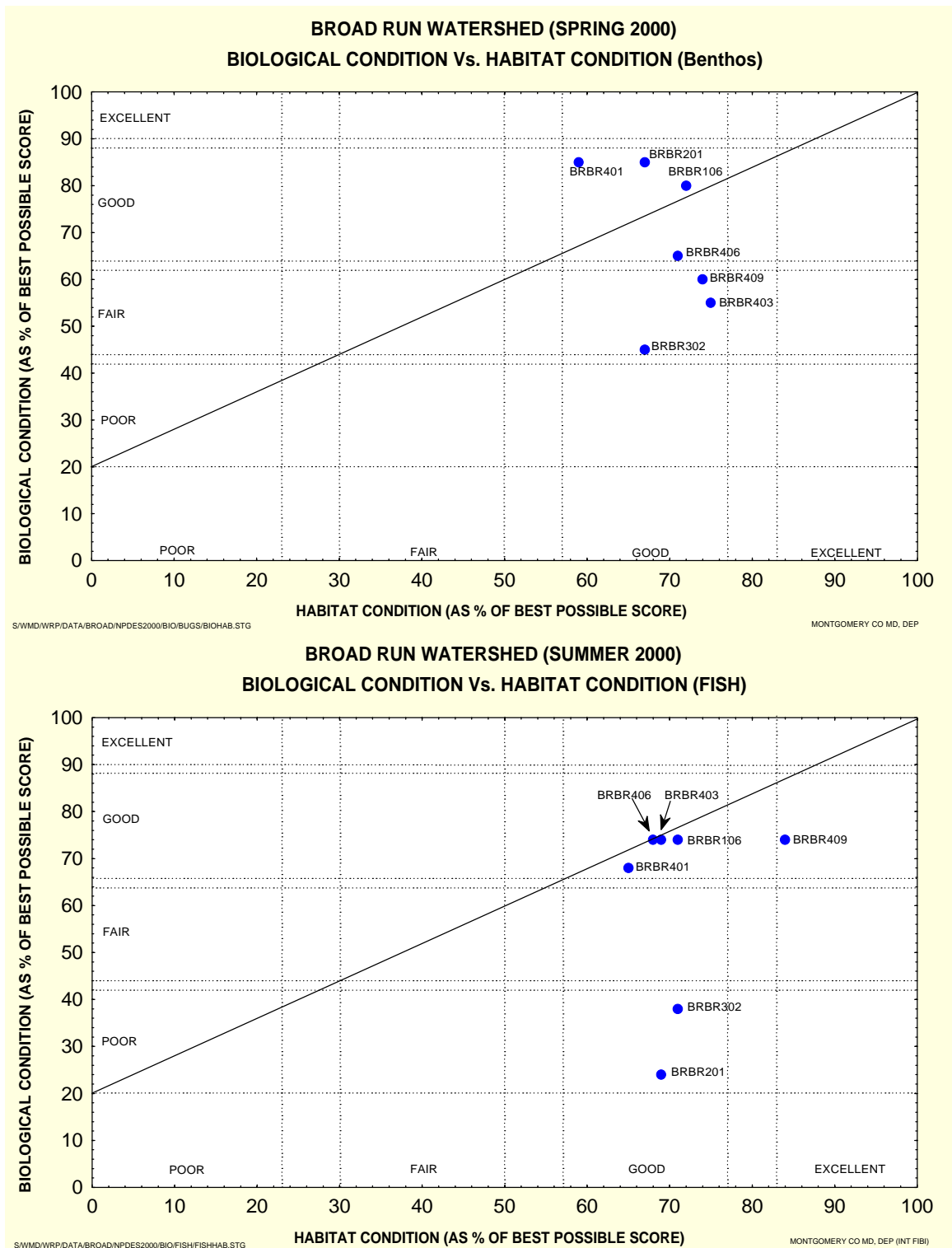


Figure 4. Biological Relationships vs. Habitat as a Percentage of the Best Obtainable Score in Broad Run

Stations of Concern

Stations identified as areas of concern from the IBI/Habitat evaluation are listed in Table 2. These stations were identified because they plotted outside of the range expected habitat/biology relationship for fish or benthics. Stations BRBR 201, 403, and 409 showed impairment in one faunal group (Table 2). Follow up monitoring will be performed during the next scheduled Broad Run Watershed monitoring.

Table 2. Stations Considered Areas of Concern for Next Broad Run Watershed Monitoring.

Monitoring Station	Location	Drainage Area	Benthic IBI	Fish IBI	Recommended Action
BRBR201	Club Hollow Road	420 Acres	Good (34)	Poor (1.2)	Examine Habitat and Field Parameters Upstream
BRBR403	Club Hollow Road	6164 Acres	Fair (22)	Good (3.7)	Examine Habitat and Field Parameters
BRBR409	River Road	8556 Acres	Fair (24)	Good (3.7)	Examine Habitat and Field Parameters

One station, BRBR302, showed an impairment affecting both faunal groups (Table 3). It is recommended that a follow up field assessment showed be performed.

Table 3. Station Considered Area of Concern.

Monitoring Station	Location	Drainage Area	Benthic IBI	Fish IBI	Recommended Action
BRBR302	Whites Ferry Road	785 Acres	Fair (18)	Poor (1.9)	Follow up habitat and field visitation in 2001

2. Rapid Habitat

Rapid habitat assessments conducted during the benthic and fish monitoring scored an overall habitat condition as good for BRBR 201, 302, 403, and 409. In the fall, quantitative habitat assessment for BRBR 201 also showed an overall good habitat quality.

Specific habitat parameters were further examined to determine if individual parameters could explain some or all of the impairment observed in the fish and benthic community. Out of our 10 habitat parameters, seven of these are good indicators of impairment from habitat stressors. The remaining three parameters were excluded for the following reasons. Channel alteration (channelization or dredging) is usually absent or minimal in County streams. The scores of bank vegetation protection usually follow those of bank stability (stable banks support a healthy vegetative cover). Finally, most riparian buffers in the County are 12 meters or greater. Scores for these three parameters are usually in the good to excellent range at all monitoring stations.

Table 4. Selected Habitat Parameters (Rapid Habitat Assessment) at Areas of Concern

Monitoring Stations		Fish Cover	Benthic Substrate	Embeddedness	Sediment Deposition	Bank Stability	Flow Status	Riffle Freq.
BRBR201	Spring 4/5	Good	Excellent	Good	Good	Good	Good	Excellent
	Summer 6/29	Good	Good	Good	Fair	Good	Fair	Excellent
	Fall 11/15	Good	Good	Good	Good	Fair	Fair	Good
BRBR302	Spring 4/27	Good	Excellent	Good	Good	Good	Good	Excellent
	Summer 6/13	Good	Good	Good	Good	Good	Excellent	Excellent
BRBR403	Spring 4/24	Excellent	Good	Excellent	Fair	Good	Good	Excellent
	Summer 7/13	Excellent	Good	Good	Fair	Good	Fair	Excellent
BRBR409	Spring 4/26	Excellent	Good	Fair	Good	Good	Good	Excellent
	Summer 6/30	Excellent	Excellent	Excellent	Good	Good	Excellent	Excellent

Predominately, most of the habitat parameters scored either a *good* or *excellent* rating throughout the monitoring year. Fish cover, riffle embeddedness, and riffle frequency all scored mostly between good and excellent condition. No habitat condition scored poor, however there were eight observations that were made in the fair range. These will be discussed next to determine if they could have contributed to the stream impairment.

According to Table 4, the sediment deposition, flow status, and bank stability may affect the overall fish community at BRBR201. This station is fairly small; it is located in a small buffer of trees next to farmland. In the spring, the sediment deposition was around 35% with old and new sandbars accumulating coarse sand and moderate deposition in the pools was noted. Channel flow status seemed to be an issue in the summer and fall seasons. During the summer and fall months, the width of the channel had decreased about 40% since spring. Bank stability scored a high fair in the fall, but scored good for the other two sampling periods. The banks may not actually be a problem, in this case, conditions out in the field may be too close to deem whether the banks were in fair or good condition.

BRBR302 seems not to show any sign that it would be the actual habitat conditions that are affecting the fish community. The benthos communities show similar signs of something affecting them other than the habitat conditions. All of the habitat scores are between good and excellent. This station is located north of Route 28 with a reasonably large buffer area. Other parameters, such as water chemistry, drainage area, water temperature, etc. will be looked at in helping to determine what is affecting the fish and benthic communities.

BRBR403's fish community showed no sign of any problems, but the benthos scored a fair. The rapid habitat (Table 4) for the summer shows that the channel width had decreased by 15% since spring, allowing riffle substrate to be exposed. This may

affect the overall effectiveness of the riffles for the benthos. Both spring and summer monitoring show old and new bars having moderate deposition of new gravel or coarse sand. 30% of the bottom is affected by the sediment deposition. This has an affect on what benthos could survive due to sediment loads. Looking at the overall benthic composition, 73% are of the family Chironomidae. In IBI scoring, these organisms are very tolerant and decrease the overall score. In this case the fish are doing well, since there is ample amount of food, but the food source are mostly tolerant individuals.

BRBR409 ranked good for the fish community but only fair for the benthos. Habitat analysis (Table 4) reveals only embeddedness would affect the overall benthic community. Fine sediments, throughout the station, surrounded the gravel, cobble, and boulder particles during the spring sampling by 65%. In the summer time, however, there seems to be no influence of sediments. There was a large amount of rain during the summertime that may have washed out the finer sediments. Similar findings were found when looking at the overall benthic community as compared to BRBR403. 71% of the benthos is identified to be in the family Chironomidae, thus decreasing the overall benthic IBI.

3. Water Quality

Physiochemical parameters measured during the monitoring year at these stations were examined for any indication of impairment from water quality stressors (Table 5). As expected, the water temperature increased from spring to summer. During the summer, dissolved oxygen and percent saturation measured just above the 5.10 mg/l and 55.7 % saturation criterion limit for State Water Use Class 1 Waters (COMAR 26.08.01-.04). State Water Use Class 1 Waters also describes normal pH values ranging between 6.5 and 8.5. Our stations showed an increase in pH from spring to summer, but it is within Maryland Department of the Environment's "normal" range. Those stations that have low dissolved oxygen (DO) and high pH may receive direct sunlight contributing to higher algae reproduction. Lastly, the conductivity levels, in the four stations of concern, appear to be under normal natural levels. Overall, there appear to be no water quality parameters that are affecting the impairment of the stream.

Table 5. Physiochemical Parameters Measured During the Monitoring Year at Areas of Concern

Monitoring Stations		Time of Day	Water Temperature (°C)	Dissolved Oxygen (ppm)	Percent DO (%)	pH	Conductivity (µmhos)
BRBR201	Spring 4/5	15:00	12.35	12.28	113	7.88	62
	Summer 6/29	13:10	21.24	5.82	64.2	8.22	83
	Fall	N/A	N/A	N/A	N/A	N/A	N/A
BRBR302	Spring 4/27	10:40	10.25	12.68	112	6.61	95
	Summer 6/13	15:05	18.95	6.03	66	7.73	161
BRBR403	Spring 4/24	N/A	N/A	N/A	N/A	N/A	N/A
	Summer 7/13	10:01	20.91	5.73	63	7.03	N/A
BRBR409	Spring 4/26	14:00	12.16	13.98	130	8.03	121
	Summer 6/30	9:45	20.06	7.26	78.6	7.90	184

4. Quantitative Habitat

Quantitative habitat was surveyed during the fall/winter of 2000 for one of the Broad Run Stations, BRBR201. Analysis of these measurements can provide further information to aid in deciding whether or not a habitat limitation, physical impairment, or water quality impairment is potentially influencing the fish and benthic macroinvertebrate communities. In addition, quantitative habitat data was examined to see any areas of accelerated habitat instability were observed.

To determine whether this stream is entrenched or not one must take the flood prone width and divide it by the bankful width (figure 5). An entrenched stream would have a range between 1.0 to 1.4, while a moderately entrenched would have 1.4 to 2.2, and slightly entrenched stream would have a calculation of greater than 2.2 (Rosgen, 1996). The survey conducted at BRBR201 indicates that this segment is moderately entrenched, 1.52. The flood prone width of this stream was determined to be 15.70 feet and a bankful width of 10.30 feet. A moderately entrenched condition will confine erosive velocities and sediments within the active channel. If the stream were slightly entrenched, floodwaters would expand out into the flood plain and allow fish to escape the high velocity channel currents. This stream reach may have widened out as far as it can and is now forming a new channel with in the former channel.

The width/depth ratio is another parameter to understanding the distribution of available energy, with various discharges, occurring within a channel to move sediment. "As the width/depth ratio value increases, i.e., the channel grows wider and more shallow), the hydraulic stress against the banks also increases and bank erosion is accelerated" (Rosgen, 1996). To calculate this ratio, bankful width is divided by mean bankful depth. BRBR201 had a bankful width of 10.30 and the mean bankful depth was determined to be 0.69, therefore the ratio was 15.0. The stream received a score of moderate, according to Rosgen's chart (1996). This indicates that there is likely channel instability within this reach of Broad Run.

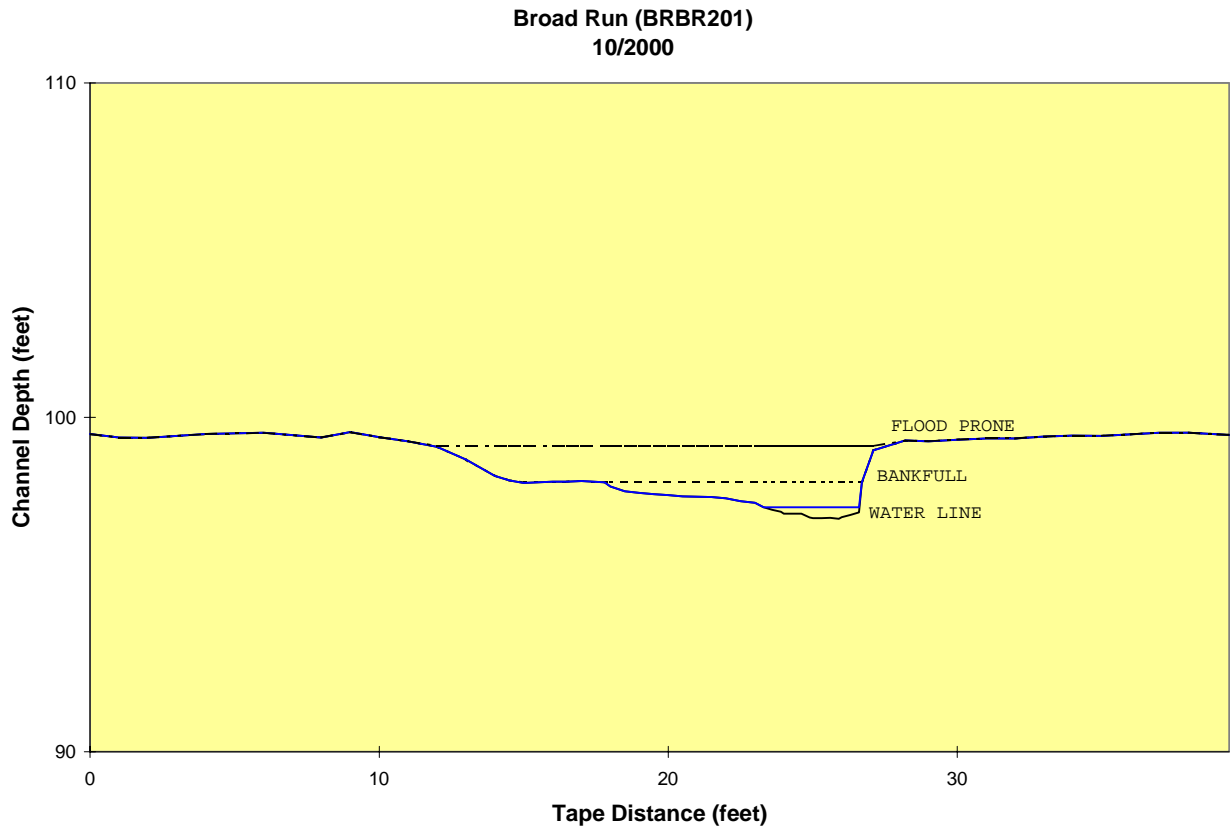


Figure 5. Moderately Entrenched Section of Broad Run Main Stem

Riffle substrates were evaluated by conducting pebble counts at all stations. Substrate analysis can determine whether or not particle size may be limiting benthic macroinvertebrate communities. The median (D^{50}) particle distribution was in the medium gravel range for BRBR201. Medium gravel is not ideal for benthic communities, but in this case the benthic community was not affected as much since they scored a *good* biological condition rating. Overall, the sizes of the riffle particles seem to be diverse.

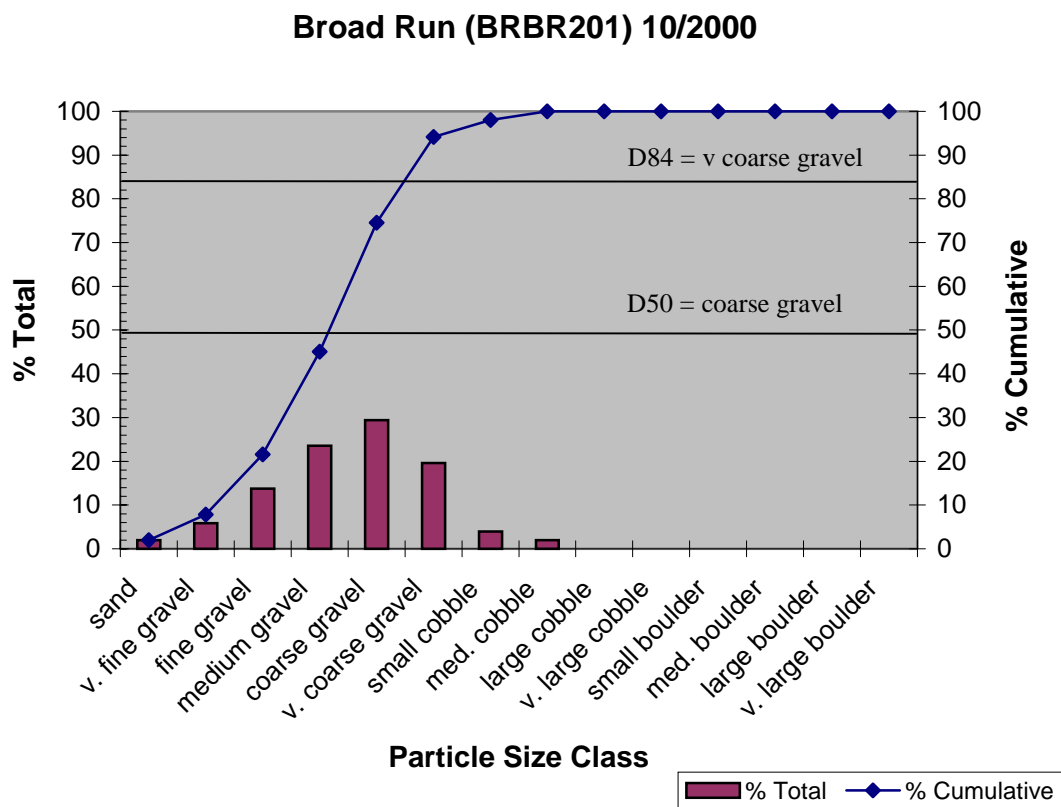


Figure 6. Analysis of Pebble Counts Taken in BRBR201's Riffle Habitat

5. Water Temperature Monitoring

Three continually recording temperature loggers were placed in Broad Run from the beginning of June through the end of September 2000 (Figure 6). Temperature readings for all three streams very rarely went above the State of Maryland's Use classification standard for class IV and never went above 27°C (80.6°F). Overall, stream temperature does not appear to be a significant limiting factor in the Broad Run Watershed.

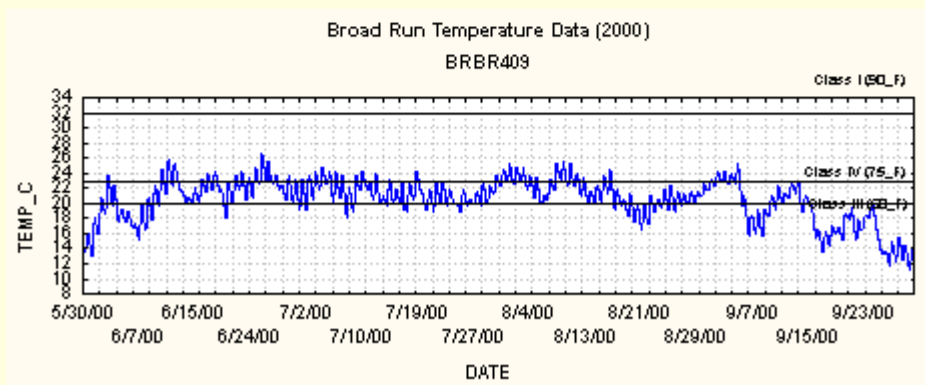
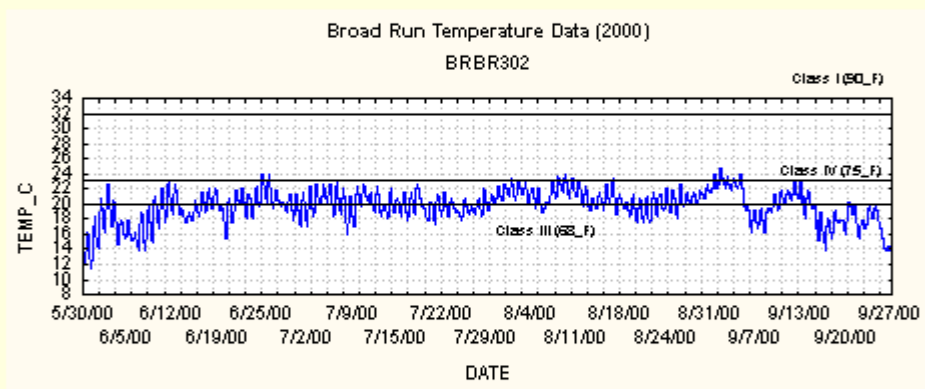
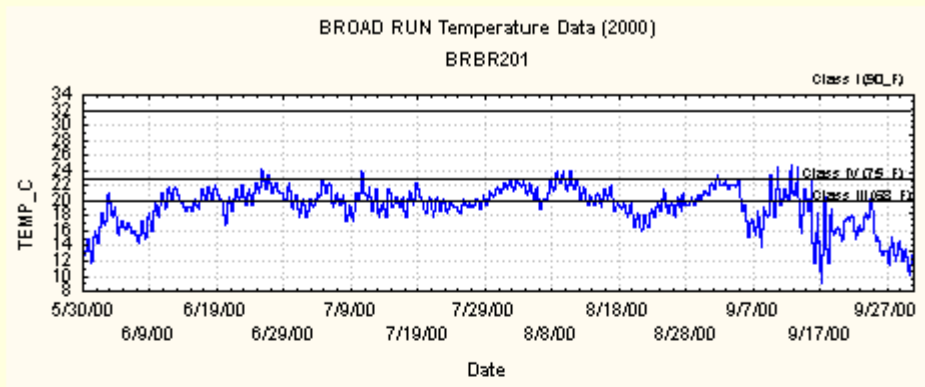


Figure 6. Stream Temperatures in Broad Run

6. Drainage Area

Drainage area is the cumulative amount of area that drains into each station of the watershed. Three hundred acres is considered to be a small drainage area. In headwater streams, fish communities do not tend to be a reliable indicator of stream conditions. Benthic communities usually are more diverse in these areas. Drainage area does not

seem to be impairing the biological communities since all stations monitored were greater than 300 acres (Table 2).

V. Discussion

Overall, three of the seven stations monitored in the Broad Run watershed in 2000 were in good health (BRBR106, 401, 406). Three other stations (BRBR 201, 403, 409) showed only one faunal group impaired in the Broad Run watershed. BRBR 302 was impaired in both faunal groups.

After reviewing the 2000 monitoring data, some of the parameters do not show significant signs of impairing Broad Run. The smallest drainage area stations revealed no impairments; its possible drainage area is not a concern. Physical chemistry samples are within COMAR's parameters written by Maryland Department of the Environment. The temperatures recorded in from the beginning of June through the end of September 2000 also did not reveal any hot or cold peaks that may affect the overall biological community.

Benthic and fish IBI ratings are lowered when a taxa dominates the sample, especially tolerant ones. Tolerant taxa are less sensitive to stream pollution and are able to withstand harsher environmental conditions where other taxa cannot. Therefore, these taxa are common and when dominating a sample they decrease the benthic IBI. Three stations (BRBR 201, 403, 409) were observed to have an overwhelming number of individual tolerant taxa. BRBR 403 and 409 had a large number of benthic individuals identified to be in the Chironomidae family (73% and 71%, respectively). This taxon is very tolerant to pollution and decreased the overall benthic IBI due to the significant number of individuals found compared to the remaining individuals in the sample. Both BRBR 403 and 409 showed *good* overall habitat score, but the individual limiting factor for the benthos may be sedimentation. BRBR 201 was observed to have pioneering fish species dominating the fish community (91%), which decreases the overall fish IBI. Pioneering species survive in low flow and can withstand various pollutions in streams. BRBR 201 is a low flow station and may not be able to sustain adequate fish habitat for for a wide diversity of fish species. This station was moderately entrenched, confining fast floodwater, thus, affecting the fish community. Physical habitat parameters at stations BRBR 201, 403, and 409 should be examined during the next scheduled monitoring of Broad Run Watershed.

BRBR302 has impairment affecting both the fish and benthic communities. Rapid habitat, temperature, and drainage area seem not to be affecting this reach. Since physical chemistry was taken as a grab sample, it may not be ruled out as impairment to this station. This station is located on a farm with a small riparian buffer. There was 68% pioneering fish species in this station that may allude to some parameter affecting this upper most station. More knowledge of what is happening upstream and downstream would benefit in finding reasons for impairment. There could be a fish blockage downstream or chemicals released upstream. Since this station is within farm property; agricultural management plans may want to be reviewed to ensure the least amount of impairment by runoff. Follow up work in water chemistry and physical habitat should be examined.

VI. Literature Cited

- MSCSPS. 1998. *Montgomery County Countywide Stream Protection Strategy*. Montgomery County Department of Environmental Protection; Rockville, MD and Maryland National Capital Planning and Park Commissions; Silver Spring, MD.
- Plafkin, J.L. et. al. 1989. *Rapid Bioassessment Protocols For Use in Streams And Rivers, Benthic Macroinvertebrates And Fish*. United States Environmental Protection Agency, Washington, D.C.
- Rosgen, D. 1996. *Applied River Morphology*. Wildland Hydrology, Pagosa Springs, Colorado.
- USDA. 1995 *Soil Survey of Montgomery County, Maryland*. United States Department of Agriculture, Natural Resources Conservation Service in cooperation with Maryland Agricultural Experiment Station and Montgomery County Soil Conservation District.
- VanNess, K., Brown, M. Haddaway, D. Jordahl, and D. Marshall. 1997 *Montgomery County Water Quality Monitoring Program: Stream Monitoring Protocols*. Montgomery County Department of Environmental Protection, Watershed Management Division, Rockville, MD.